PRESENCE OF AN ORCHID BEE (*EUGLOSSA* SP.) NEST AND AN ANT (*CREMATOGASTER LIMATA PALANS*) NEST IN A CACAO POD (*THEOBROMA CACAO*) (HYMENOPTERA: APIDAE, FORMICIDAE, RESP.)[1]

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ABSTRACT: An arboreal rotten cacao pod in Costa Rica contained one nest each of *Crematogaster limata palans* (Hymenoptera: Formicidae) and the orchid bee, *Euglossa* sp. (Hymenoptera: Apidae). The bee apparently is an undescribed species. About 2.5 weeks after the bee nest was discovered, the four blackish, resinous brood cells produced four female bees over a ten-day period. There was no evidence that *Euglossa* re-used the nest cavity. No interactions between the ants and bee nest were noted. A detailed description of the orchid bee nest is presented, along with information on the ant colony.

Although nest structure is an important taxonomic character for infrageneric classification of orchid bees of the genus *Euglossa* (Hymenoptera: Apidae: Bombinae: Euglossini) (Dressler 1978), relatively little is known about the nesting habits of many species (Zucchi et al., 1969; Wilson 1971). The data available on the nests of some *Euglossa* species indicate both cavity-nesting in the ground and free-standing arboreal nests attached to twigs and leaves (e.g., Friese 1899; Bennett 1966; Roberts and Dodson 1967; Zucchi et al., 1969; Dressler 1978; 1982; Young 1985). The co-occurrence of other organisms within the cavity nests of *Euglossa* is virtually unstudied. In this communique, I describe a nest of an apparently undescribed species of *Euglossa* (R.L. Dressler, pers. comm. to L.S. Kimsey) inside an arboreal, rotted pod of cacao (*Theobroma cacao* L.) (Sterculiaceae) in northeastern Costa Rica, and the simultaneous occurrence of a colony of the ant *Crematogaster limata palans* Forel (Hymenoptera: Formicidae, Myrmeciinae), in the same pod. The nest structure, temporal pattern of bee emergence, sex ratio of *Euglossa* along with notes on the ant colony, are reported.

MATERIALS AND METHODS

On 2 August 1984, forty rotten pods were collected from several cacao trees at "Finca La Tigra" (10°24'N; 84°60'W), near La Virgen (220 m. elev.), Sarapiqui District, Heredia Province, Costa Rica. Each pod was

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gently cut open to collect insects. One pod examined contained a sticky resinous mass of bee brood cells and an ant colony. The clump of bee brood cells was gently removed and photographed and returned to its original position in the pod cavity. The entire pod cavity was briefly checked for the presence of bees. To observe subsequent bee emergences and ant activity, the removed pod wall fragment was re-attached with a rubber band to leave the cavity contents undisturbed for several weeks. The pod was kept on moistened paper towels in a tightly-closed clear-plastic bag, and checked several times daily for bee emergences and ant activity. All bees were retained for sex and taxonomic determinations. Before and after bee emergences, the next structure was examined. The location and size of the ant colony were also described.

RESULTS

Description of Bee-Ant Occupied Pod. The appoximately 14 cm long & 6 cm wide cacao pod containing the bee and ant nests was found about 2 m above the ground in a densely-shaded cacao tree. Unlike most of the pods collected, this pod was hard and mummified. The only apparent opening in the pod was an irregularly-shaped hole, approximately 1 cm across, where the pod joins the petiole. Internally, about 2/3 of the central cavity of the pod was filled with rotted, moist cacao seeds, although the distalmost 1/3 (about 35 x 40 mm) of the cavity, containing the bee nest (Fig. 1), was free of seed (even though seeds usually fill the entire pod cavity).

Description of Bee Nest. The bee nest consisted of four completely closed (capped) brood cells (range of 16-20 mm high and 8-10 mm wide) arranged as a tight cluster and fused basally (Fig. 1). Although seemingly amorphous at the base, the bottom of each brood cell appeared round and bulbous when viewed directly from below. Each brood cell had a bulbous apical cap area (4 mm high) prior to bee emergences (Fig. 1). The cells were sticky and blackened, and appeared to be resinous. The external texture of the brood cells was granular. The cluster of cells was positioned freely (unattached) within the pod cavity. There was no evidence of additional nest material (resin).

Bee Emergence, Sex Ratio, and Determinations. At the time of discovery, one dead female bee, in excellent condition, was found along side the nest. Beginning 20 August 1984, about 2.5 weeks after the nest was discovered, the first of four bees emerged. Three days later, a second bee emerged, and two days after that a third bee emerged. The fourth bee emerged 10 days after the first emergence. All bees were found in the bag containing the pod before 1100 h, although exact time of emergence was not

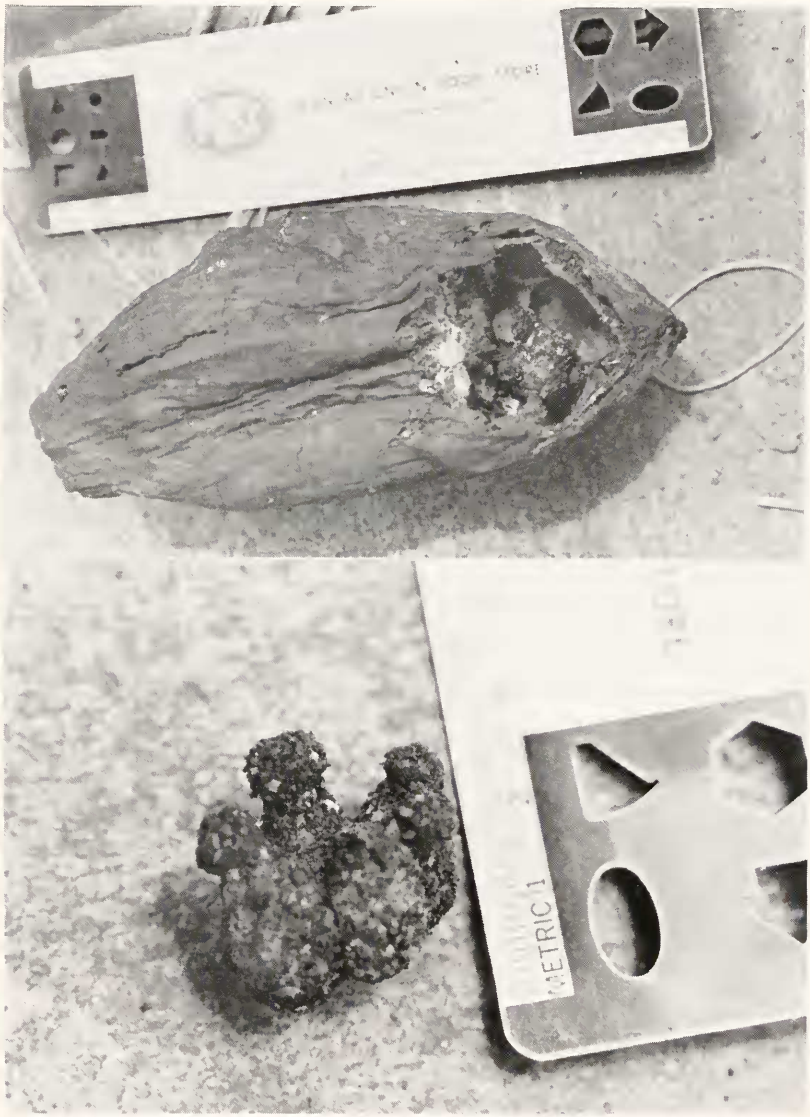

Fig. 1. Above: The rotten cacao pod showing the location of the four-celled *Euglossa* nest within the distal portion of the central cavity. A piece of the pod wall has been temporarily removed to show the position of the nest, but was re-attached for subsequent rearing of bees. Below: Lateral view of the four brood cells comprising the *Euglossa* nest. Note the granular texture of the resinous cells and the bulb-like apical area on each cell. Scale in mm.

determined. All four bees matched the dead bee found in the pod cavity. Bees emerged just below the bulbous, apical caps of the brood cells (Fig. 2) and exited the pod through the hole near the petiole, since no other exit holes were found. In three of the four cells, the apical cap was still attached, at one side, after bee emergence (Fig. 2); on the fourth, the cap was completely broken off. The line of perforation of cap lids on all four cells was immediately below the apical bulbous portion of the brood cell (Fig. 2). The diameter of each emergence hole was 5 mm. The five reddish-bronze-colored bees (14 mm long) were all female *Euglossa* sp. Structurally, the bees resemble *E. purpurea* Friese, but other discrepancies suggest that it might be a different species (R.L. Dressler and L.S. Kimsey, pers. comms.). Without males, it is very difficult to confirm species determination in *Euglossa,* and there are many undescribed species (L.S. Kimsey, pers. comm.).

Ant Nest and Activity. A colony, consisting of approximately 50 workers, of the 3-mm long black ant, *Crematogaster limata palans* Forel, was found inside one of the rotted seeds in the cavity of the cacao pod. A few pupae (brood) were also present. The colony may have occupied more than one cacao seed, but the majority of ants were found in one seed, embedded

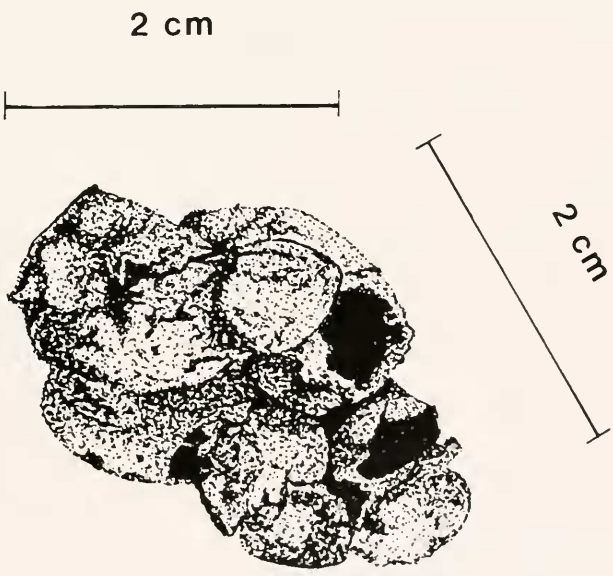

Fig. 2. Scale drawing of the *Euglossa* brood cells (4) following bee emergences. One bee emerged from each cell. Note positions of perforated "caps" on three of the cells.

in the moist rotted seed tissues. Very little ant activity was observed over the approximately one-month observation period the pod was confined for rearing. It was apparent, since all bees emerged successfully, that *C. limata palans* did not attack bee pupae. Nor did the ants consume the fresh corpse of the adult bee found in the pod cavity prior to its discovery (2 August). A few ants were seen almost daily crawling over the external surface of the pod, but no definitive diurnal activity pattern was ascertained. Several other pods collected also contained colonies of *C. limata palans* but no additional orchid bee nests were found.

DISCUSSION

Given the little information available to date on nesting habits of *Euglossa* species, there are generally two major patterns: (1) concealed cavity-nesting species which usually construct nests in the ground or in the debris lodged around the roots of epiphytes, and (2) aerial nesting species which construct free-standing resin nests attached to twigs and leaves (e.g., Dressler 1978; 1982, and included references). Using nest structure and several other taxonomic characters, Dressler (1978) recognizes several distinct groupings of *Euglossa* species. Within Dressler's "Group XI" there are eight species, including *E. purpurea* Friese. Species in "Group XI" are cavity-nesting bees, opportunistically building nests in pre-existing cavities in the ground and presumably elsewhere (Dressler 1978). Assuming the *Euglossa* species examined here is a close relative of *E. purpurea,* the data on nest structure might be of interest in increasing our knowledge of those characters distinguishing Group XI species from others in Dressler's infrageneric classification (Dressler 1978).

Aerial nests of *Euglossa* usually consist of several brood cells encased in an external resinous envelope (e.g., Dodson 1966; Roberts and Dodson 1967; Young 1985). Brood cells without an external envelope, as described in this paper, are typical of *Euglossa* nesting in ground cavities (e.g., Zucchi et al., 1969). But similar nests of *E. ignita chlorosoma* Cockerell have been found in fern fibers at the bases of arboreal orchid plants in Peru (Roberts and Dodson 1967).

Relative to what has been described for arboreally-nesting *E. ignita* (Roberts and Dodson 1967), the nest size in this paper is relatively small but not unusual. The *Euglossa* species in the cacao pod nests arboreally in concealed moist cavities such as cacao pods. Rotted cacao pods have a woody endocarp and they do not fall off the tree. Such a microhabitat might be an ideal arboreal nesting site for some *Euglossa* species.

It could not be ascertained whether the female bee constructing the four brood cells actively cleared (excavated) the cavity free of cacao seeds, or if

she made the exit hole in the pod. But *Euglossa* species nesting in ground cavities enlarge pre-existing cavities and nest entrances (Roberts and Dodson 1967; Zucchi et al., 1969).

Given the fresh condition of the dead female bee in the pod cavity and the bee emergence schedule, the duration of the pupal stage was probably between 20-25 days. Because of the moist condition inside the pod cavity and the presence of an ant species which is known to scavenge (Young 1983), had the dead bee been there much earlier than the date it was discovered, its body would have been badly decomposed or scavenged. It is very likely that the dead bee was the mother of the 4 bees emerging from the nest, and that she died shortly after the final provisioning of the brood cells.

The absence of old, used brood cells, and the successive emergence of bees from all four new brood cells in the *Euglossa* nest in the cacao pod is evidence of a solitary life cycle in this species. Solitary life cycles characterize many species of *Euglossa* (Dodson 1966; Zucchi et al., 1969; Young 1985). *Euglossa* species require between 60-90 days for egg-to-adult development for the few species in which such data are available (Roberts and Dodson 1967; Zucchi et al., 1969; Young 1985). Assuming a 60-day life cycle for the species studied here, nest construction would have been initiated in late June or early July, corresponding to the rainy season at this locality. Other species of *Euglossa* are known to construct nests in the rainy season (e.g., Friese 1922), even though emergence is suspected throughout the year (Ackerman 1983).

Crematogaster limata palans nests arboreally in rotten cacao pods in Costa Rica, even though it scavenges on the ground as well (Young 1983). Although bee activity in the pod may have been for two months or more, there is no apparent deleterious effect of ants on bee development. Given the location of the exit hole from the pod, at the opposite end from the bee nest, emerging bees and a provisioning mother would be exposed to some level of ant activity. *Euglossa* may posses some chemical or behavioral defenses against ants, and brood cells may be chemically protected. Undoubtedly the chance occurrence of an *Eugloosa* nest in a cacao pod with ants is very small. Alternatively, the nest of *C. limata* may have been sealed off by the mother bee.

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